B.E. Part II, 4th Semester Examination, 2010

Subject: Strength of Materials **Subject Code: AM-405**

Branch: Met. & Min. Engineering

Full Marks: 70 **Time : 3hours**

FIRST HALF

(Answer Question No. 1 and ANY TWO from rest)

1. Choose the correct alternative: [5x/]

   a) The maximum compressive stress in a simply supported beam loaded with u.d.l. over its entire length occurs in (i) top-most fiber, (ii) fiber passing through neutral axis, (iii) bottom-most fiber, (iv) 2/3 rd of the depth from top.

   b) The section modulus of a beam section of rectangular shape with width' b and depth h is given by (i) $\frac{bh^3}{12}$, (ii) $\frac{bh^2}{6}$, (iii) $\frac{bh^2}{3}$, (iv) $\frac{b^2h}{6}$.

   c) The total angle of twist θ for a circular shaft of length l subjected to a torque T is given by i) $\frac{TG}{IJ}$, (ii) $\frac{Tl}{GJ}$, (iii) $\frac{Tl}{IT}$ and (iv) $\frac{T}{rJ}$.

   d) The unstable end condition for a long column is (i) hinge-fixed, (ii) hinge-hinge, (iii) fixed-free, (iv) hir\ge-free.

   e) For a given uniform cross section of a transversely loaded beam bending stress vanishes at (i) extreme fibers, (ii) neutral axis, (iii) at $1/3^{rd}$ depth of the section, (iv) none of these.

2. A laminated wood beam is made up of three 60mmx 120mm planks glued together to form a solid cross-section of 120mm wide x 180mm depth. The beam is simply supported over a span of 2.5 m with a concentrated load P at the center of the span. The allowable shear stress for the glued joints is 65 Mpa. Find the safe maximum value of P and the maximum normal bending stress at the beam for that safe maximum value of P. *[J5]*

3. A solid metallic shaft has to transmit a power of 150 HP at 170 r.p.m. If the shear stress is not to exceed 700 kg/cm^2 and the angle of twist in a length of 3 m must not exceed 1°, find a suitable diameter of the shaft. Take G = 8 x 10^5 kg/cm^2. *[15]*

4. A 6 m long beam is having 200 mm depth over the entire span where as it has 100 mm width over the left half of the span and 150 mm width over the remaining span. If the beam is subjected to a concentrated load of 60 kN at mid-span,calculate the deflection of the beam at mid-span. *[15]*

5. A short cylindrical strut of diameter 200 mm and height 600 mm is loaded by a concentrated load of 40 kN placed centrally at the top of the strut. A groove of depth 200 mm is cut in the strut at a height of 200 mm from the bottom such a way that the grooved portion of the strut is having a semicircular cross section of diameter 200 mm. Calculate the maximum compressive stress at the cross section of the strut at a height of 300 mm from bottom. *[J5]*

(Answer O. No.6 and any two from the rest)

6. Choose the best response: **1x5**

(i) **The shape of stress-strain curve of MS tensile specimen from proportional range to elastic range is: linear / curvilinear / cup & cone / none of these.**

(ii) **Mechanical stress induced in a structural member due to temperature change reduces to zero for: completely rigid support / partially rigid support / fully yielding support / none of these.**

(iii) **The ratio of longitudinal strain to lateral strain is:** $\frac{ft}{M}$ **/ — / //² / none of these.**

(iv) **In a mild steel specimen, the nature of fracture subjected to tensile loading is designated as : brittle type fracture / shear type fracture / compound type fracture / cup Acone type fracture.**

(v) **Point of contraflexure is the point where: S.F. changes its sign / B.M. changes its sign / S.F. & B.M. both change their signs / none of these.**

7. A tensile stress was conducted on a M.S. bar in Amsler Universal Testing Machine. The following data was obtained from the test: diameter of the bar = 2cm, gauge length = 10cm, load at elastic limit = 30 kN, extension,at a load of 18 kN is 0.21mm, maximum load = 56 kN, total extension = 52mm, diameter of the rod at failure = 1.25cm. Determine modulus of elasticity, stress at elastic limit, % elongation and % contraction in area. 15

8. A metal beam ABC simply supported at points A and B, 6m apart has an overhang BC of 2m. Three point loads of 20kN, 30kN and 40 kN are placed on the. beam at distances Im, 3m and 7m away respectively from support A. Draw the shear force diagram and bending moment diagram for this transversely loaded beam. Mark values at salient points of these diagrams. 15

9. A steel tube of 30mm external diameter and 26mm internal diameter encloses a copper rod of 20mm diameter to which it is rigidly joined at each end. The temperature of the whole assembly is raised to 110°C and the nuts on the rod are then screwed lightly home on the ends of the tube. Find the intensity of stress in the rod when the common temperature has Men to 30°C. Take E, = 2.1 x 10^5 MPa, E. = 0.8 x 10^5 MPa, «, = 12x lO^per °C, a* = 18 x 10^{-6} per°C. 15

10. (a) Derive the expression of normal stress and shearing stress for block subjected to only biaxial normal stresses,

(b) With the help of Mohr's circle find out the magnitude of normal and shearing force for an angle $\langle f \rangle$ **= 30° while** CT_x **= lOOAYPaand** a_y **= -\00MPa . 05 +10**